Emotional Landscapes: Enhancing Well-Being in Antarctica Through Personalized Audio-Visual Projections and Generative AI

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Abstract: This work presents the design of an audio-visual (AV) intervention to mitigate the psychological challenges experienced in confined and extreme environments. It presents initial findings of an experiment that tested its effects in Antarctica through an interdisciplinary collaboration between architects, environmental psychologists, and media artists. The novelty of this work lies in using video projections with varying landscape content and imagery type (literal or abstract, the latter created using Generative AI), and testing them in a real-life extreme environment at the Bulgarian Antarctic base "St. Kliment Ohridski".

The AV stimuli developed for this study enabled, for the first time to our knowledge, a direct comparison between human-captured natural landscapes and geometrically abstracted visuals generated via a real-time AI pipeline based on Diffusion Models (DMs) in extreme environments. Designed to operate offline, a critical requirement in remote environments, the pipeline used an open-source DM to generate abstract visual representations that systematically reduced the informational complexity of human-captured footage. These transformations were achieved via text-to-video and video-to-video techniques, overlaid with animated Perlin 3D noise. To measure the effectiveness, we pre-rendered the final video footage (Image 2a-c) while preserving certain image characteristics such as the average color and luminance for the same landscape content (Image 2d-f). The study also examined familiarity by using two types of natural landscapes, forest and icescape, along with an urban environment. The videos were 16 minutes long, rendered in 1920x1080, with audio matching the visual (i.e., birdsong, ice floating, or urban sounds of equal loudness).

The experiment followed a 3x2 within-subjects design, with landscape content (forest, icescape, urban environment) and imagery type (literal, abstract) as factors. A total of 13 participants (10 male, 3 female), inhabitants of the Bulgarian Antarctic Base, aged between 35 and 56 years, took part in the study. Each took part in three experimental sessions within a dedicated experimental room where they conducted office-like tasks while exposed to the AV projections (see Supplementary Images). In each session, participants were exposed in random order to both imagery types in the same landscape content, selected randomly, and physiological measures (HR, EEG) and self-reports were recorded. This paper examines the effects of landscape content and imagery type on self-reported ratings of relaxation, fascination, liking, complexity, disturbance, and distraction.

Analyses were conducted with Linear Mixed Models (LMM) with content, type, and their interaction used as fixed effects, and the participant number as a random intercept. The session number was used as a covariate to account for possible confounding effects. Results showed that content significantly influenced ratings of relaxation ($F(2, 60) = 15.84$, $p < .0001$; all other ps >.05), with the urban environment being rated as less relaxing than both the icescape ($B = -2.71$, $p < .0001$) and the forest ($B = -2.38$, $p = .0001$), and no significant differences between icescape and forest ($p = .89$) Moreover, a significant interaction was found between content and type for ratings of liking ($F(2, 58.24) = 6.41$, $p = .003$; all other ps >.078) and fascination ($F(2, 58.23) = 5.07$, $p = .009$). Pairwise comparisons showed that content levels only differed between them for the literal and not the abstract type. For the literal type, results are in alignment with those of relaxation, showing that the urban environment was rated lower in liking and in fascination than both the icescape (liking: $B=-2.69$, $p = .001$; fascination: $B=-2.38$, $p =.006$) and the forest (liking: $B=-3.93$, $p <.0001$; fascination: $B=-3.30$, $p <.001$) (all other ps >.20 for liking and >.50 for fascination). Regarding fascination, results also showed a

main effect of type ($F(1, 58) = 4.57$, $p = .04$), but estimated marginal means were almost identical. Lastly, no significant effects of type, content, their interaction, or session were found regarding how complex (all ps >.14), disturbing (all ps >.08), or distracting (all ps >.07) the projection was perceived.

Results

Our findings demonstrate that the effects of landscape content on liking and fascination depend on imagery type, with differences appearing only for literal landscape depictions. Conversely, for relaxation, content was the main driver of responses, independently of imagery type. Lastly, the AI-generated abstract imagery was not perceived as more complex, disturbing, or distracting. Although our sample size is limited, the outcomes of this work showcase the potential of generative AI in extreme environments and motivate further work in designing emotionally attuned and context-sensitive interventions, which are essential in extreme environments where psychological well-being is closely linked to sensory conditions.

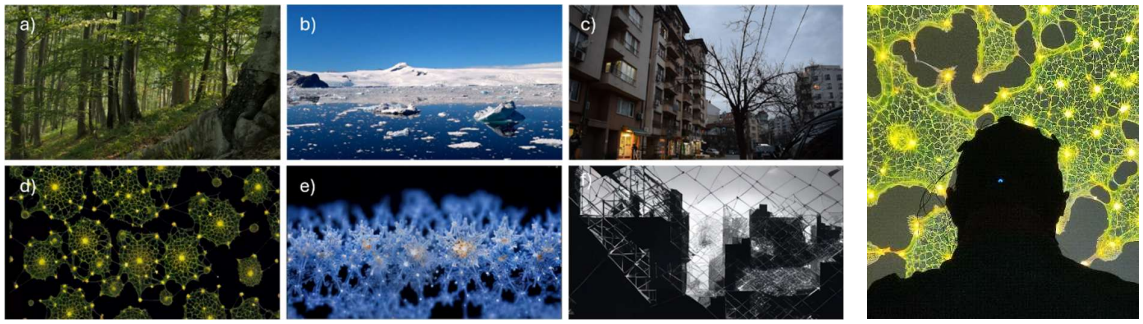

Image 2: (Left) Varying landscape content (forest: a, d; icescape: b, e; urban environment: c, f) and imagery type (literal: a-c, abstract: d-f) (Right) Photograph during the study.

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